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Patentanmeldung Nr. **Patent application No.** **Demande de brevet n°**

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Der Präsident des Europäischen Patentamts;
Im Auftrag

For the President of the European Patent Office

Le Président de l'Office européen des brevets
p.o.

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DEN HAAG, DEN
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[ABSTRACT]

FAST SCREENING METHOD FOR TRIBO-ELECTRICAL PROPERTIES

A method is disclosed for screening an array of multiple test samples on their tribo-electrical properties, said method comprising following steps :
(a) dispensing on a support in sheet form multiple test samples in an array of predefined regions, whereby the nature and/or concentration of at least one ingredient in said test samples is varied according to combinatorial design;
(b) subjecting said multiple test samples on said support simultaneously to an appropriate post-treatment;
(c) tribo-charging in parallel said array of multiple test samples, and screening in parallel said array of charged multiple samples for their tribo-electrical properties.

[DESCRIPTION]

FIELD OF THE INVENTION

The present invention relates to a method for optimizing the tribo-electrical properties of web- and sheet-fed materials.

BACKGROUND OF THE INVENTION

Tribo-electrical properties of film materials are frequently not well known and understood, and can have an enormous impact upon the ease and cost of manufacturing and packaging them.
In case of a typical example of silver halide film materials for medical and graphical applications, said film materials are delivered to the customers in boxes, containing e.g. 100 individual sheets of fixed format. These film materials are used in their specific application field and can come in contact with other surfaces: for example, a silver halide film for radiography can come into contact with the phosphor plate during the exposure step and if unwanted charging occurs, spark discharges are possible resulting in unwanted image densities and even unappropriate conclusions of the doctor relying upon the aquired images.
The film itself is placed in boxes during the packaging step of the fabrication process and here again contact of different films (back to front) can lead to unwanted tribocharging resulting in sparks and resulting latent image artefacts, or even repulsion of one sheet versus the other leading to errors in filling the boxes.
So for many film applications it is required that 1/ said tribocharging can be measured; 2/ said materials can be adapted so that the unwanted tribo-charging can be prevented.
This is not a straightforward task, since the characterisation of the tribo-charging is very difficult and depends upon a lot of environmental circumstances.
As a consequence it is very difficult to compare tribo-characteristics for different materials if they have been developed

on different substrates during different process stages at different times.
There are a lot of other applications wherein tribo-electrical properties play a crucial role in the well-behaviour of the applications at the customer and / or manufacturer.
Transparant overhead projection foils typically are non-conductive plastic materials that easily pose problems in the stacker unit of a large electrophotographic copier. Too high tribo-charging can lead to foil-to-glass plate sticking and "paper jam", or to foil-to-foil repulsion and problems in the stacker unit. Similar problems can be encoutered in ink jet printers using sheed-fed materials for which the tribo-charging properties are not well tuned.
If tribo-electrical properties of printing plates are not well tuned, excessive tribo-charging of the isolating image-forming layer may lead to the problem of sticking together for multiple printing plates so that it is very difficult for the operator to work with these individual plates.
Thermal printing systems based on dye diffusion thermal transfer and wax-transfer systems have typically organic coating compositions with tends to easy tribo-charging. Excessive charges can cause transport problems in the printers and lead to missing images.
The problem of unwanted tribo-charging of surfaces is not only limited to printing applications. In the production of glass plates e.g. one expects at the end that different plates can be put nicely together on a single stack. However, if excessive surface charging occurs, then the different glass plates will repell each other and a nice stack cannot be delivered to the customer. Other examples are e.g. floor carpets that are wound on rolls and where unwanted tribocharging might deteriorate the roll quality.
For clean room environments textiles are used with well designed conducting properties. This can be achieved with interweaving conducting fibers into the textiles. On the other hand for typical single-use cloths extruded plastics can be used. In this case proper surface treatment to end up with optimal tribo-electrical properties is required.

It must be clear that many applications are waiting for a fast screening method to register and optimize the tribo-electrical properties.

Fast screening methods according to the principles of combinatorial design are known for quite a time in various scientific and technological disciplines. When used for developing new material or improving existing ones the method is commonly known as "Combinatorial Materials Science (CMS)". A forerunner of CMS is known as the "Multiple Sample Concept (MSC)", developed by J.J. Hanak. A survey of publications on MSC can be found in the minutes of The First Gordon Research Conference on "*Combinatorial and High Throughput Materials Science*", June 30 - July 5, 2002, Kimbal Union Academy, Meriden, NH.

Another review has been presented by Jandeleit et al., *Angew. Chem. Int. Ed.*, 1999, 38, 2494-2532. Many references to material design by combinatorial techniques can be found in this review. Combinatorial search for advanced luminescence materials has also been described in *Biotech. & Bioeng.*, (Combinatorial Chemistry), vol. 61, no. 4, pp. 193-201. Combinatorial techniques for developing new materials have also been extensively used in the patent literature: e.g. US-P-5,985,356, US-P-6,004,617, US-P-6,030,917, US-P-6,043,363, US-P-6,045,671 and US-P-6,034,775. In US-P 6,004,617 and US-P 5,985,356 methods and apparatus are disclosed for the preparation and use of a substrate having an array of diverse materials in predefined regions thereon. Materials which can be prepared using the methods and apparatus of the reference include, for example, intermetallic materials, metal alloys, ceramic materials, organic materials, organometallic materials, non-biological organic polymers, composite materials (e.g., inorganic composites, organic composites, or combinations thereof), etc. Once prepared, these materials can be screened for useful properties including, electrical, thermal, mechanical, morphological, optical, magnetic, chemical, or other properties.

SUMMARY OF THE INVENTION

It is the object of the present invention to provide a fast screening method for optimizing the tribo-electrical properties of an array of samples corresponding to the compositions of coated layers.

The above-mentioned object is realised by a method for screening an array of multiple test samples on their tribo-electrical properties, said method comprising following steps :

(a) dispensing on a support in sheet form multiple test samples in an array of predefined regions, whereby the nature and/or concentration of at least one ingredient in said test samples is varied according to combinatorial design;

(b) subjecting said multiple test samples on said support simultaneously to an appropriate post-treatment;

(c) tribo-charging in parallel said array of multiple test samples, and screening in parallel said array of charged multiple samples for their tribo-electrical properties.

Further advantages and embodiments of the present invention will become apparent from the following description and drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 shows a schematic representation of a preferred embodiment of an apparatus used in accordance with the present invention, said apparatus having following principal parts :

- a grounded rotatable drum (1) for holding a support in sheet form bearing the samples to be measured ; it is driven by a servo-motor (2); on its axis an encoder (3) is fixed for synchronisation;
- a charging roller (4), positioned above said drum (1), consisting of or covered with a tribo-electric reference material; it has an axis which is held by bearing holders (5) which can be moved up and down by pressure air cylinders (6);
- a measuring probe (7) connected to an electrostatic voltmeter (8), and mounted in front of the drum on a spindle (9) driven by a second servo-motor (10);
- a PC (11) equipped with suitable software (12) and a suitable interface (13) for sending data to drive (14) the motors and the

encoder, and for receiving and handling measuring data from the electrostatic voltmeter.

DETAILED DESCRIPTION OF THE INVENTION

The present invention will now be explained in more detail on the hand of its preferred embodiments.
As stated above, fast screening methods based on combinatorial design are known for the investigation of various properties of various types of material. However, to our best knowledge, it is the first time that such a method is used for investigating the tribo-electrical properties of an array of samples.
In a first step (a) of the method of the present invention multiple test samples are dispensed on a support in sheet form in an array of predefined regions, whereby the nature and/or concentration of at least one ingredient in said test samples is varied according to combinatorial design. The dispensing of the samples on the support can be performed by any suitable means, e.g. a pipette or micro-pipette.
The geometry of the array of predefined regions may take any form, but preferably, it is simply a rectangular grid comprising rows and columns.
The support in sheet form for holding the array of test samples may be any suitable rigid support, and may, for instance be chosen from the type of supports well-known from photographic industry.
Paper types include plain paper, cast coated paper, polyethylene coated paper and polypropylene coated paper. Polymeric supports include cellulose acetate propionate or cellulose acetate butyrate, polyesters such as polyethylene terephthalate and polyethylene naphthalate, polyamides, polycarbonates, polyimides, polyolefins, poly(vinylacetals), polyethers and polysulfonamides. Other examples of useful high-quality polymeric supports for the present invention include opaque white polyesters and extrusion blends of polyethylene terephthalate and polypropylene. Polyester film supports and especially polyethylene terephthalate are preferred because of their excellent properties of dimensional stability. When such a polyester

is used as the support material, a subbing layer may be employed to improve the bonding of the hydrophilic layer(s) to the support. Useful subbing layers for this purpose are well known in the photographic art and include, for example, polymers of vinylidene chloride such as vinylidene chloride /acrylonitrile /acrylic acid terpolymers or vinylidene chloride /methyl acrylate /itaconic acid terpolymers. A preferred polymer of the latter type is co(vinylidenechloride-methylacrylate-itaconic acid ; 88 % / 10 % / 2 %). A most suitable subbing layer contains the latter polymer and a colloidal silica such as KIESELSOL 100F (Bayer AG). Optionally to this composition can be added co(methylacrylate-butadiene-itaconic acid) (49/49/2), preferably in a ratio of about 10 %. The most favourable adhesion properties are obtained when a subbing layer as described above provided with an additional primer layer containing gelatin (preferably 0.25 - 0.35 g/m²), Kieselsol 300 F (0.30 - 0.40 g/m²) and a matting agent on the base of polymethylmethacrylate (average size 2 à 3 mm) at a coverage of about 0.001 g/m².

The at least one variable ingredient may be varied over both rows and columns of the combinatorial array, or the ingredient may be varied only from row to row but over each row kept constant, or vice versa for the columns.
Apart from the varable additive the samples contain a set of ingredients which are kept constant over the total array or part of the array in the experiment. The set of constant ingredients can be applied in two fundamentally different ways. The set can simply be present in each separate sample to be dispensed together with the at least one variable additive. In an alternative embodiment the set of constant ingredients is incorporated in a separate precoat covering the whole area of the support, and the different samples which are subsequently dispensed comprise only the at least one variable additive ("missing component principle").
In a preferred embodiment of the present invention the at least one additive which is varied, and/or the ingredients which are held constant are chosen from the typical ingredients of photographic materials based on silver halide emulsion technology. Such ingredients

include in the first place a silver halide emulsion which is essentially composed of a protective hydrophilic binder, usually gelatin, and a silver halide, chosen from silver bromide, silver chloride or mixed bromide-chloride-iodide salts. The photographic emulsion(s) can be prepared from soluble silver salts and soluble halides according to different methods as described e.g. by P. Glafkidès in "Chimie et Physique Photographique", Paul Montel, Paris (1967), by G.F. Duffin in "Photographic Emulsion Chemistry", The Focal Press, London (1966), and by V.L. Zelikman et al in "Making and Coating Photographic Emulsion", The Focal Press, London (1966). They can be prepared by mixing the halide and silver solutions in partially or fully controlled conditions of temperature, concentrations, sequence of addition, and rates of addition. The silver halide can be precipitated according to the single-jet method, the double-jet method, the conversion method or an alternation of these different methods.

The silver halide emulsions can be doped with various metal salts or complexes such as Rhodium and Iridium dopants.

The emulsion can be desalted in the usual ways e.g. by dialysis, by flocculation and re-dispersing, or by ultrafiltration.

The light-sensitive silver halide emulsions are preferably chemically sensitized as described e.g. in the above-mentioned "Chimie et Physique Photographique" by P. Glafkidès, in the above-mentioned "Photographic Emulsion Chemistry" by G.F. Duffin, in the above-mentioned "Making and Coating Photographic Emulsion" by V.L. Zelikman et al, and in "Die Grundlagen der Photographischen Prozesse mit Silberhalogeniden" edited by H. Frieser and published by Akademische Verlagsgesellschaft (1968).

The light-sensitive silver halide emulsions can be spectrally sensitized with proper dyes such as those described by F.M. Hamer in "The Cyanine Dyes and Related Compounds", 1964, John Wiley & Sons. Dyes that can be used for the purpose of spectral sensitization include cyanine dyes, merocyanine dyes, complex cyanine dyes, complex merocyanine dyes, hemicyanine dyes, styryl dyes and hemioxonol dyes. Particularly valuable dyes are those belonging to the cyanine dyes, merocyanine dyes and complex merocyanine dyes.

Apart from spectrally sensitizing dyes the silver halide emulsion composition or other hydrophilic compositions which are meant to be coated as auxiliary layers, e.g. a backing layer, an undercoat layer,

or a protective top layer may contain other types of dyes such as antihalation dyes, acutance dyes and correction dyes.
The silver halide emulsion(s) for use in accordance with the present invention may comprise compounds preventing the formation of fog or stabilizing the photographic characteristics during the production or storage of photographic elements or during the photographic treatment thereof. Many known compounds can be added as fog-inhibiting agent or stabilizer to the silver halide emulsion. Suitable examples are disclosed in *Research Disclosure* Item 36544, September 1994, Chapter VII.
Besides the silver halide another essential component of a light-sensitive emulsion composition is the binder. The binder is a hydrophilic colloid, preferably gelatin. Gelatin can, however, be replaced in part or integrally by synthetic, semi-synthetic, or natural polymers.
The binders of the photographic element, especially when the binder used is gelatin, can be hardened with appropriate hardening agents such as those of the epoxide type, those of the ethylenimine type, those of the vinylsulfone type e.g.1,3-vinylsulphonyl-2-propanol, chromium salts e.g. chromium acetate and chromium alum, aldehydes e.g. formaldehyde, glyoxal, and glutaraldehyde, N-methylol compounds e.g. dimethylolurea and methyloldimethylhydantoin, dioxan derivatives e.g. 2,3-dihydroxy-dioxan, active vinyl compounds e.g. 1,3,5-triacryloyl-hexahydro-s-triazine, active halogen compounds e.g. 2,4-dichloro-6-hydroxy-s-triazine, and mucohalogenic acids e.g. mucochloric acid and mucophenoxychloric acid. These hardeners can be used alone or in combination. The binders can also be hardened with fast-reacting hardeners such as carbamoylpyridinium salts as disclosed in US 4,063,952.
The samples of the photographic emulsion composition and/or of the compositions for auxiliary layers may further comprise various kinds of other ingredients, such as lubricants, plasticizers, matting agents, spacing agents, whitening agents, UV-absorbers, and surfactants.

In the practice of this invention surfactants are particularly preferred as variable additive for combinatorial design because of their important influence on the coating properties and on the antistatic properties of coated hydrophilic layers.

They can be any of the cationic, anionic, amphoteric, and non-ionic ones as described in JP-A 62-280068 (1987). Examples of the surfactants are N-alkylamino acid salts, alkylether carboxylic acid salts, acylated peptides, alkylsulfonic acid salts, alkylbenzene and alkylnaphthalene sulfonic acid salts, sulfosuccinic acid salts, α-olefin sulfonic acid salts, N-acylsulfonic acid salts, sulfonated oils, alkylsulfonic acid salts, alkylether sulfonic acid salts, alkylallylethersulfonic acid salts, alkylamidesulfonic acid salts, alkylphosphoric acid salts, alkyletherphosphoric acid salts, alkylallyletherphosphoric acid salts, alkyl and alkylallylpolyoxyethylene ethers, alkylallylformaldehyde condensed acid salts, alkylallylethersulfonic acid salts, alkylamidesulfonic acid salts, alkylphosphoric acid salts, alkyletherphosphoric acid salts, alkylallyletherphosphoric acid salts, alkyl and alkylallylpolyoxyethylene ethers, alkylallylformaldehyde condensed polyoxyethylene ethers, blocked polymers having polyoxypropylene, polyoxyethylene polyoxypropylalkylethers, polyoxyethyleneether of glycolesters, polyoxyethyleneether of sorbitanesters, polyoxyethyleneether of sorbitolesters, polyethyleneglycol aliphatic acid esters, glycerol esters, sorbitane esters, propyleneglycol esters, sugaresters, fluoro C_2-C_{10} alkylcarboxylic acids, disodium N-perfluorooctanesulfonyl glutamate, sodium 3-(fluoro-C_6-C_{11}-alkyl-oxy)-1-C_3-C_4 alkyl sulfonates, sodium 3-(ω-fluoro-C_6-C_8-alkanoyl-N-ethylamino)-1-propane sulfonates, N-[3-(perfluorooctanesulfonamide)-propyl]-N,N-dimethyl-N-carboxymethylene ammonium betaine, fluoro-C_{11}-C_{20} alkylcarboxylic acids, perfluoro-C_7-C_{13}-alkyl-carboxylic acids, perfluorooctane sulfonic acid diethanolamide, Li, K and Na perfluoro-C_4-C_{12}-alkyl sulfonates, N-propyl-N-(2-hydroxyethyl)perfluorooctane sulfonamide, perfluoro-C_6-C_{10}-alkylsulfonamide-propyl-sulfonyl-glycinates, bis-(N-perfluorooctylsulfonyl-N-ethanolaminoethyl)phosphonate,

mono-perfluoro C_6-C_{16} alkyl-ethyl phosphonates, and perfluoroalkylbetaine.

Useful cationic surfactants include N-alkyl dimethyl ammonium chloride, palmityl trimethyl ammonium chloride, dodecyldimethylamine, tetradecyldimethylamine, ethoxylated alkyl guanidine-amine complex, oleamine hydroxypropyl bistrimonium chloride, oleyl imidazoline, stearyl imidazoline, cocamine acetate, palmitamine, dihydroxyethylcocamine, cocotrimonium chloride, alkyl polyglycolether ammonium sulphate, ethoxylated oleamine, lauryl pyridinium chloride, N-oleyl-1,3-diaminopropane, stearamidopropyl dimethylamine lactate, coconut fatty amide, oleyl hydroxyethyl imidazoline, isostearyl ethylimidonium ethosulphate, lauramidopropyl PEG-dimoniumchloride phosphate, palmityl trimethylammonium chloride, and cetyltrimethylammonium bromide.

Especially useful are the fluorocarbon surfactants as described in e.g. US-P 4,781,985, having a structure of :

$F(CF_2)_{4-9}CH_2CH_2SCH_2CH_2N^+R_3X^-$ wherein R is a hydrogen or an alkyl group; and in US-P 5,084,340, having a structure of:

$CF_3(CF_2)_mCH_2CH_2O(CH_2CH_2O)_nR$ wherein m = 2 to 10; n = 1 to 18; R is hydrogen or an alkyl group of 1 to 10 carbon atoms. These surfactants are commercially available from DuPont and 3M.

As explained above the surfactants varying in nature and/or composition may be incorporated in multiple composition samples having a defined constant set of other ingredients. Or the set of other constant ingredients may be incorporated in a separate precoat which may be applied over relative large areas of the support and only the varying surfactants are dispensed in a combinatorial array on top of this precoat ("missing component principle).

The method of the present invention comprises a second step (b) being an appropriate post-treatment simultaneously for all samples in the experiment. This appropriate post-treatment depends on the nature of the ingredients in the samples and may be, for instance, a

drying step, a jellifying step, a thermal treatment, a UV-curing step, and combinations thereof.

We will now explain in more detail the apparatus used in accordance with the present invention and the way it functions in the practice for performing step (c) of this invention.
According to a preferred embodiment step (c) of the method of the present invention is performed by an apparatus, as represented by Fig. 1 (see also the section Brief Description of the Drawings), and having the following principal parts :
- a grounded rotatable drum (1) for holding the substrate in sheet form bearing the samples to be measured ;
- a charging roller (4), positioned above said drum (1), consisting of or covered with a tribo-electric reference material;
- a measuring probe (7) connected to a voltmeter (8) for measuring electrostatic potentials, and mounted in front of the drum on a spindle (9);
- a PC (11) for handling outgoing and incoming data.

A concrete typical in-house built apparatus obeying the definitions given above has following components.
Input and output data are controlled by a personal computer (11) : HP Vectra XA Pentium 1, 200 MHz; operating system : Windows NT4.0 ; driven by in-house written software CVI/Labwindows (12). The interface between PC and device is a DAQ card (13): LABPC+ of National Instruments with 8 analogue In (12 bit), 2 Analogue Out (12 bit), 24 Digital I/O, 83 Ksamples/s.
The center of the device is a rotatable drum (1) (diameter 229 mm, width 650 mm) to which the sheet carrying the array of test samples can be fastened. The drum is driven via its axis by means of a servo-motor (2).
At both sides of the drum two bearing holders (5) upon pressure air cylinders (6) are mounted. In the bearing holders different charging rollers (4) can be mounted consisting of or covered with the tribo-electric reference material. Preferably this roller is made of a dissipative material.

On the drum axis an encoder (3) is applied for synchronisation purpose. The encoder can send 360 pulses/revolution or 1 pulse/revolution. In the set up described here the zero-passage (1 pulse/revlution) (digital) is transmittted to the DAQ card as synchronisation.

A spindle (9) (pitch = 2.5 mm/revolution) is mounted in front of the rotatable drum and the measuring probe (7), made of messing, of the electrostatic voltmeter (8) is fixed to it. The linear translation speed of the measuring probe is controled by the DAQ card in function of the desired scan resolution. The spindle is also driven by a servo-motor (10).

The signals of the electrostatic voltmeter (TREK 368 or 370) (analogue) are offered to the analogue entry of the DAQ card. The sample frequency is set up depending on the desired resolution.

Step (c) of the method of the present invention using the apparatus described above is now explained in more detail.

The sheet carrying the test samples to be examined and the reference material are preferably preconditioned.

In the bearing holders (5) the charging roller (4) consisting of or covered with the tribo-electric reference material is mounted.

The sheet carrying the test samples is cut into the desired format and fastened to the rotatable drum (1) with the side to be measured upside.

The program is started and the parameters of the experiment are entered in the PC (11). The measuring probe (7) is brought to its starting position on the spindle (9) at the left side. The speed of the drum is brought gradually to 30 rpm. Subsequently the average rotation speed is determined from 5 rotations (5 zero-passages).

Depending on the desired resolution the spindle speed and sample time are adjusted.

The spindle is started and the measuring probe moves laterally from left to right over the width of the drum. Of each sheet carrying test samples a blank recording is made without contact with the reference material roller. By means of a pressure air valve the reference material roller is lowered and brought in contact with the

drum and the recording is started again. The pressure is determined by the own weight of the roller and the roller is not driven itself. The potential data coming from the electrostatic voltmeter (8) are stored by the PC in an array of rows and columns. The zero passage indicated by the encoder signal marks the start of a new column. The data can be graphically reproduced after conversion to a false color code. The program converts the data going from -1000 V to +1000 V into 31 different colors. The width of potential corresponding to each color is not linear over the complete potential domain ; around 0 V the resolution is highest. The array of colors can be displaied on the PC monitor.

In order to reach a plateau value of chargeability for each sample it is necessary to make and break contact with the charging roller (4) multiple times. By applying several sample spots in the width with the same composition, in other words by varying the variable additive only over the different rows of the array but keeping it constant for each row over the width, it can be determined how the charging evolves as a function of the number of revolutions which corresponds to the number of contacts for each sample. By breaking at the end of the experiment the contact with charging roller (4) the relaxation of the charging can be followed as a function of time.
By choosing at least two different reference materials for the surface of the charging roller which are tribo-electrically distant from each other a good idea can be obtained of the electrostatic properties of each sample.

The present invention will now be illustrated by the following example withtout however being limited thereto.

EXAMPLE

The following surfactants were tested for their influence on the tribo-electric properties of a typical hydrophilic gelatinous layer.

Surfactant 1 (SF-1) : $C_7H_{15}-COONH_4^+$

Surfactant 2 (SF-2) : C_8H_{17}-phenyl-$(O-CH_2-CH_2)_8-O-CH_2-COOH$

In the experiment the concentration of the gelatin is also varied. Three different stock solutions were prepared having following compositions :

(A) 3.5 g of 1% gelatin + 300 ml water + 0.5 g of a dye

(B) 3.5 g of 2% gelatin + 150 ml water + 0.5 g of a dye

(C) 3.5 g of 1.5% gelatin + 225 ml water + 0.5 g of a dye

To the stock solutions the surfactants SF-1 and SF-2 were added or not added resulting in eight compositions as illustrated in the following table 1.

TABLE 1

Comp. No.	Stock sol.	SF-1 (µl)	SF-2 (µl)	Water
1	A	0	0	667
2	A	133	0	533
3	A	0	200	467
4	B	0	0	333
5	B	133	0	200
6	B	0	200	133
7	C	133	0	366
8	C	0	200	300

The compositions were dispensed on a polyethylene terephthalate sheet of appropriate dimensions in an array of 8 rows and 10 columns. The composition of the samples of each row corresponded to the compositions given in table 1. The compositions were held constant over the width of each row. Two experiments of tribo-electric charging and measuring were performed with the in-house

built apparatus as extensively described in the previous section. In the first experiment the charging roller consisted of rubber. In the second experiment the surface of the roller was covered with a sleeve of nylon. The measured surface potentials in volts, measured along column 7 when the charging plateau is reached, are summarized in table 2.

TABLE 2

Sample No.	Additive	Nylon	Rubber	Chargeability (Rubber - Nylon)
1	None	- 25	267	292
2	SF-1	-119	- 60	59
3	SF-2	19	339	320
4	None	- 10	174	184
5	SF-1	-134	- 94	40
6	SF-2	21	335	314
7	SF-1	-105	-100	5
8	SF-2	19	338	319

Conclusion : the combination with either surfactant can be good or bad depending on the potential problem. So the use of surfactant 2 is to be preferred when there are specific electrostatic problems vis-à-vis nylon sleeves mounted over rollers as currently used in the coating alleys of the photographic industry. On the other hand if a problem would occur of tribo-electric charging against a rubber suction roller the surfactant 1 would be the better choice. When looking for a surfactant which is globally better the tribo-electric position is less important than the chargeability. It is clear that SF-1 is in that case the best choice in view of its lower chargeability.

Having described in detail preferred embodiments of the current invention, it will now be apparent to those skilled in the art that

numerous modifications can be made therein without departing from the scope of the invention as defined in the appending claims.

[CLAIMS]

1. A method for screening an array of multiple test samples on their tribo-electrical properties, said method comprising following steps:
(a) dispensing on a support in sheet form multiple test samples in an array of predefined regions, whereby the nature and/or concentration of at least one ingredient in said test samples is varied according to combinatorial design;
(b) subjecting said multiple test samples on said support simultaneously to an appropriate post-treatment;
(c) tribo-charging in parallel said array of multiple test samples, and screening in parallel said array of charged multiple samples for their tribo-electrical properties.

2. A method according to claim 1 wherein said support is precoated with a layer comprising a set of defined ingredients other than said at least one varying ingredient.

3. A method according to claim 1 wherein each test sample further comprises, apart from said at least one varying ingredient, a set of other defined ingredients.

4. A method according to claims 2 or 3 wherein said set of other ingredients comprises typical ingredients of an emulsion layer or an auxiliary layer of a silver halide based photographic material.

5. A method according to any of claims 1 to 4 wherein said varying additive is a surfactant or mixture of surfactants.

6. A method according to any of claims 1 to 5 wherein said appropriate post-treatment of step (b) is chosen from a drying step, a jellifying step, a thermal treatment, a UV-curing step, or combinations thereof.

7. A method according to any of claims 1 to 6 wherein said step (c) is performed by means of an apparatus comprising the following principal parts :
   - a grounded rotatable drum (1) for holding the support in sheet form bearing the samples to be measured ;
   - a charging roller (4), positioned above said drum (1), consisting of or covered with a tribo-electric reference material;
   - a measuring probe (7) connected to a voltmeter (8) for measuring electrostatic potentials, and mounted in front of the drum on a spindle (9);
   - a PC (11) for handling outgoing and incoming data.

8. A method according to claim 7 whereby the rotatable drum (1) has an axis to which an encoder (3) is fixed for synchronisation.

9. A method according to claim 7 or 8 wherein the axis of said roller (4) is held by bearing holders (5) which can be moved up and down by pressure air cylinders (6).

10. A method according to any of claims 7 to 9 wherein said rotatable drum (1) and said roller (4) are both driven by servo-motors (2) and (10).

11. A method according to any of claims 7 to 10 wheren said PC (11) is equipped with suitable software (12) and a suitable interface (13) for sending data to drive said motors (2) and (10) and said encoder (3), and for receiving and handling measured potential data from said electrostatic voltmeter (8).

12. A method according to any of claims 7 to 11 wherein said roller (4) is made of a dissipative material.

13. A method according to claim any of claims 7 to 12 wherein said roller (4) is a rubber roller or a roller with a rubber surface.

14. A method according to any of claims 7 to 12 wherein said roller (4) is a roller covered with a nylon sleeve.

15. A method according to any of claims 7 to 14 wherein said step (c) comprises the following substeps, in order :
(c.1) said support in sheet form carrying said array of test samples to be measured is fastened around said rotatable drum (1);
(c.2) said charging roller (4) consisting of or covered with a tribo-electric reference material is mounted in said bearing holders (5);
(c.3) the rotation of the drum is started and by means of appropriate output data sent by the PC the desired rotation speed of the drum, the speed of the spindle, and the sampling time are set up;
(c.3) the spindle is started and the measuring probe (7) moves laterally over the width of the rotating drum, which is not yet in contact with roller (4), thereby sending blank electrostatic signals to the voltmeter, and the measuring probe returns to its original position;
(c.4) the roller (4) is moved down and brought in contact with the rotating drum,
(c.5) the spindle is started again and the measuring probe moves again over the width over the drum thereby capturing the electrostatic potential variations caused by the tribo-electric charging of the different samples, and sending them to the voltmeter;
(c.6) the potential data of the voltmeter are transmitted to the PC which stores them in an array of lines and colums corresponding to the geometry of the array of samples on the sheet-like substrate;
(c.7) the data are converted by the PC software into a false color code, which can be represented graphically on the PC screen as a two-dimensional array.

16. A process according to claim 13 whereby said false color code can be represented as a color bar comprising 31 different colors

representing 31 different electrostatic potential classes varying between -1000 V and =1000 V.

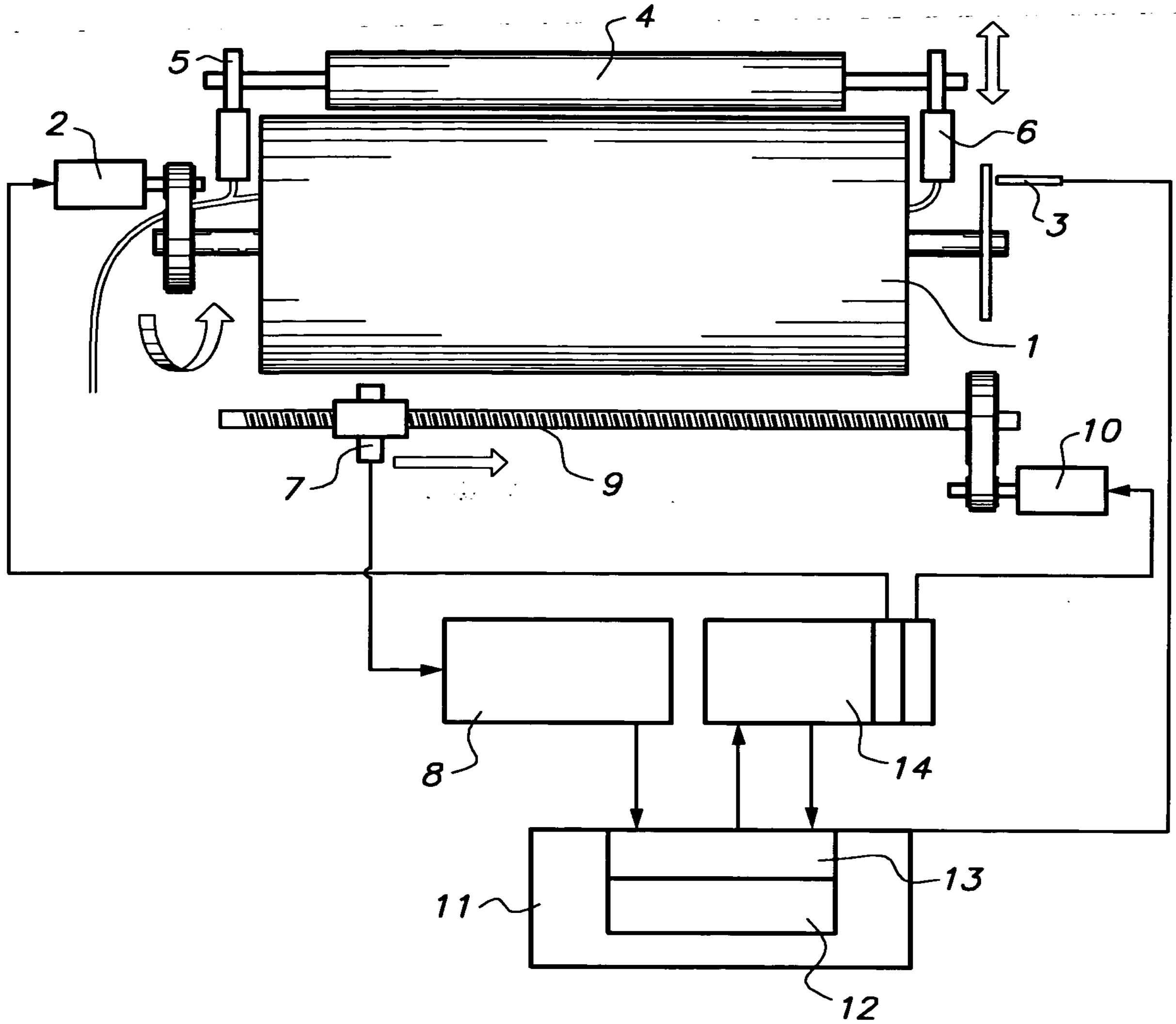

FIG. 1

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